

## **The NASA/AFRL Meter Class Autonomous Telescope**

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### **ABSTRACT**

For the past decade, the NASA Orbital Debris Program Office (ODPO) has relied on using various ground-based telescopes in Chile to acquire statistical survey data as well as photometric and spectroscopic data of orbital debris in geosynchronous Earth orbit (GEO). The statistical survey data have been used to supply the Orbital Debris Engineering Model (ORDEM) v.3.0 with debris detections in GEO to better model the environment at altitudes where radar detections are limited. The data produced for the statistical survey ranged from 30 to 40 nights per year, which only accounted for ~10% of the possible observing time. Data collection was restricted by ODPO resources and weather conditions. In order to improve the statistical sampling in GEO, as well as observe and sample other orbits, NASA's ODPO with support from the Air Force Research Laboratory (AFRL), has constructed a new observatory dedicated to orbital debris – the Meter Class Autonomous Telescope (MCAT) on Ascension Island.

This location provides MCAT with the unique ability to access targets orbiting at an altitude of less than 1,000 km and low inclinations ( $< 20$  deg). This orbital regime currently has little to no coverage by the U.S. Space Surveillance Network. Unlike previous ODPO optical assets, the ability to operate autonomously will allow rapid response observations of break-up events, an observing mode that was only available via radar tasking prior to MCAT's deployment.

The primary goal of MCAT is to statistically characterize GEO via daily tasking files uploaded from ODPO. These tasking files define which operating mode to follow, providing the field center, rates, and/or targets to observe over the entire observing period. The system is also capable of tracking fast-moving targets in low Earth orbit (LEO), middle Earth orbit (MEO), as well as highly eccentric orbits like geostationary transfer orbits.

On 25 August 2015, MCAT successfully acquired scientific first light, imaging the Bug Nebula and tracked objects in LEO, MEO, and GEO. NASA is working towards characterizing the system and thoroughly testing the integrated hardware and software control to achieve fully autonomous operations by late 2016.

This paper will review the history and current status of the MCAT project, the details of the telescope system, and its five currently manifested operating modes.

### **Text Summary**

The NASA Orbital Debris Program Office (ODPO), with support from the Air Force Research Laboratory (AFRL), has constructed a new observatory dedicated to orbital debris – the Meter Class Autonomous Telescope (MCAT) on Ascension Island. MCAT is capable of tracking fast-moving targets in low Earth orbit, middle Earth orbit, and geosynchronous Earth orbit as was demonstrated during scientific first light on 25 August 2015. This paper will review the history and current status of the MCAT project, details of the telescope system, its five currently manifested operating modes, and its value to the NASA orbital debris environmental models.